TREATMENT EFFICACY OF NONCONTINGENT REINFORCEMENT DURING BRIEF AND EXTENDED APPLICATION

JANA S. LINDBERG

BRIGHAM YOUNG UNIVERSITY

BRIAN A. IWATA

UNIVERSITY OF FLORIDA

EILEEN M. ROSCOE

NEW ENGLAND CENTER FOR CHILDREN

APRIL S. WORSDELL

BANCROFT NEUROHEALTH

AND

GREGORY P. HANLEY

UNIVERSITY OF KANSAS

We evaluated the long-term therapeutic effects of noncontingent reinforcement (NCR). In Experiment 1, NCR effects were examined with 2 participants' arbitrary responses; in Experiment 2, NCR was used as treatment with 3 participants whose self-injurious behavior (SIB) was maintained by automatic reinforcement. In both experiments, NCR consisted of continuous access to a highly preferred leisure item and was implemented initially during 10-min and later during 120-min sessions. Varied reinforcers (leisure items) were subsequently introduced during 120-min sessions to determine if treatment effects might be extended. Finally (Experiment 2 only), NCR was implemented throughout the day in participants' homes. Results of Experiments 1 and 2 showed that reinforcers obtained through object manipulation can compete with those obtained automatically by engaging in SIB during brief NCR sessions. However, data from the 120-min sessions indicated that satiation to a specific leisure item might occur over periods of time more typical of those during which treatment would be implemented. Access to a variety of highly preferred leisure items extended the effectiveness of NCR for some individuals. When NCR was implemented throughout the day (Experiment 2), therapeutic effects were shown to be maintained for up to 1 year.

DESCRIPTORS: automatic reinforcement, functional analysis, noncontingent reinforcement, stimulus preference assessment

---

Noncontingent reinforcement (NCR) has been used successfully as treatment for a

wide range of problem behaviors (Carr et al., 2000). Most applications of NCR include an extinction component. That is, the reinforcer responsible for behavioral maintenance is delivered according to some response-independent schedule but is not delivered following occurrences of the target behavior.

The combined implementation of NCR

and extinction is easily arranged when problem behavior is maintained by social contingencies because the reinforcers delivered under NCR and withheld under extinction are functionally identical. For example, Mace and Lalli (1991) observed large decreases in an individual's bizarre vocalizations, which were maintained by social-positive reinforcement (attention), when attention was delivered according to a variable-time schedule but was withheld following the target behavior. Vollmer, Marcus, and Ringdahl (1995) described a similar arrangement for self-injurious behavior (SIB) maintained by social-negative reinforcement. The authors observed large reductions in SIB when brief breaks (periods of escape) from ongoing task demands were delivered on a fixed-time (FT) schedule rather than following occurrences of SIB.

A different situation exists when problem behavior is maintained by nonsocial (automatic) reinforcement, because it may be difficult or impossible either (a) to withhold access to a reinforcer that is a direct result of the behavior or (b) to deliver the same reinforcer through means other than the target response itself (Shore & Iwata, 1999). Thus, applications of NCR with problem behavior maintained by automatic reinforcement typically have involved delivery of an arbitrary reinforcer in the absence of extinction (e.g., Roscoe, Iwata, & Goh, 1998; Vollmer, Marcus, & LeBlanc, 1994). That is, reinforcement for problem behavior remains available during NCR, and problem behavior decreases to the extent that the arbitrary reinforcer competes with the maintaining reinforcer.

Although NCR has been shown to be effective in reducing problem behavior maintained by both social and automatic reinforcement, almost all evaluations of NCR have been limited to brief sessions, ranging in duration from 5 to 15 min (cf. Hagopian, LeBlanc, & Maglieri, 2000). It is unclear if NCR would remain effective when used over longer periods of time that are more characteristic of therapeutic (nonexperimental) application. This question is particularly important when NCR is used as treatment for problem behavior maintained by automatic reinforcement.

Because the same reinforcer that maintains the target behavior is delivered during treatment when NCR is applied to behavior maintained by social reinforcement, repeated exposure to reinforcers over a long period of time would be expected to eliminate the behavior's establishing operation (EO; Michael, 1982, 1993). Thus, satiation during treatment is not a concern and actually could be a beneficial side effect. By contrast, because a reinforcer that does not maintain problem behavior is delivered when NCR is applied to behavior maintained by automatic reinforcement, satiation to the arbitrary reinforcer might diminish its therapeutic effects without necessarily altering the EO for problem behavior. As a result, problem behavior is more likely to recur because it produces access to a different stimulus (i.e., the maintaining reinforcer) whose reinforcing effects have not diminished. For example, DeLeon, Anders, Rodriguez-Catter, and Neidert (2000) suggested that satiation may have accounted for decreases in leisure-item manipulation and increases in SIB that they observed while implementing NCR during 30-min sessions, and this phenomenon may not be more evident in published research simply because session length typically has been brief. When DeLeon et al. either (a) periodically switched leisure items during the session or (b) made more than one leisure item available during the session, leisure-item manipulation was maintained at high levels and SIB remained low.

The purpose of this study was to examine NCR during brief and extended sessions with behavior maintained by automatic reinforcement to determine whether NCR ef-

fects deteriorate over time. A second purpose was to determine whether satiation could be prevented through the use of multiple reinforcers (i.e., reinforcer variation). Two experiments were conducted: Experiment 1 was conducted in a nonclinical context (i.e., the target response was object manipulation with a lower preference item rather than SIB); Experiment 2 provided a systematic replication during the assessment and treatment of SIB.

EXPERIMENT 1

We evaluated the long-term effects of NCR under nonclinical conditions by observing the relation between behaviors analogous to target and alternative behaviors when NCR is used to treat behavior maintained by automatic reinforcement. When NCR involves the presentation of a preferred leisure item and effectively reduces SIB, manipulation of the leisure item is, by definition, a response that is preferred over SIB. Thus, manipulation of a moderately preferred leisure item was considered analogous to engaging in SIB, whereas manipulation of a highly preferred leisure item was considered analogous to "consuming" the competing reinforcer delivered noncontingently during treatment.

During baseline, one leisure item was available. This situation was comparable to conditions that exist when SIB maintained by automatic reinforcement is observed during typical baseline sessions. That is, the individual is placed in an environment in which little reinforcement is available except by engaging in SIB. During NCR sessions, the leisure item available during baseline was present, but so was a more preferred leisure item. This situation was analogous to the conditions of a treatment session in that, during NCR, the individual may obtain reinforcement by engaging in SIB or by consuming the reinforcer that is delivered noncontingently.

The study was conducted in three phases. In the first phase, participants' preference for a number of leisure items was assessed. In the second phase, participants' manipulation of one or two items was recorded during brief sessions. In the third phase, object manipulation was recorded during extended sessions. Access to the specific leisure items was limited to experimental sessions.

METHOD AND RESULTS

Participants and Setting

Two individuals enrolled in a sheltered workshop program for persons with developmental disabilities participated. Matthew was a 32-year-old man who had been diagnosed with moderate mental retardation. He was ambulatory, followed multistep instructions, and communicated vocally. Angela was a 38-year-old woman who had been diagnosed with severe mental retardation. She was ambulatory, followed two-step instructions, and communicated primarily through gestures and a few manual signs. Neither participant engaged in any problem behaviors.

All sessions were conducted at the sheltered workshop. Matthew's sessions were conducted in an area containing a small table and a few chairs that was partitioned from the main workshop area. Angela's sessions were conducted in a conference room containing a large table and several chairs.

Response Measurement and Reliability

The dependent variable was object manipulation, defined as holding or physically manipulating a leisure item. Data were collected on handheld computers during continuous 10-s intervals and were summarized as the percentage of intervals during which responding occurred. Interobserver agreement was assessed by having a second observer independently collect data during

38.5% and 47% of Matthew's and Angela's sessions, respectively. Observers' records were compared on an interval-by-interval basis, and an agreement was scored for each interval in which both observers recorded either the presence or absence of behavior. Agreement scores were calculated by dividing the number of intervals containing agreements by the total number of intervals and multiplying by 100%. Mean agreement scores were 99.0% (range, 96.7% to 100%) and 97.3% (range, 74.4% to 100%), respectively, for Matthew's and Angela's object manipulation.

Phase 1: Preference Assessment

Participants' preference for 10 leisure items was assessed using procedures described by Fisher et al. (1992). Prior to the assessment, the therapist familiarized the participant with each item. During each trial of the assessment, the therapist placed two items next to each other on a table approximately 30 cm in front of the participant. An approach response to one item produced 30-s access to that item while the other item was removed (attempts to approach both items were blocked). If neither stimulus was approached within 5 s, the therapist prompted the participant to sample each item and then repeated the trial. If the participant did not approach either item when the trial was repeated, the therapist removed both items and initiated a new trial with two different items. Each item was paired once with every other item, with the order of presentation determined randomly.

Figure 1 shows the percentage of trials on which each item was selected during the assessment. Items are listed from left to right in descending order based on the number of trials in which they were selected. Matthew chose the beads and string on 100% of the trials and the sports magazine on 11% of the trials; these items were selected as his high-preference (HP) and low-preference (LP)
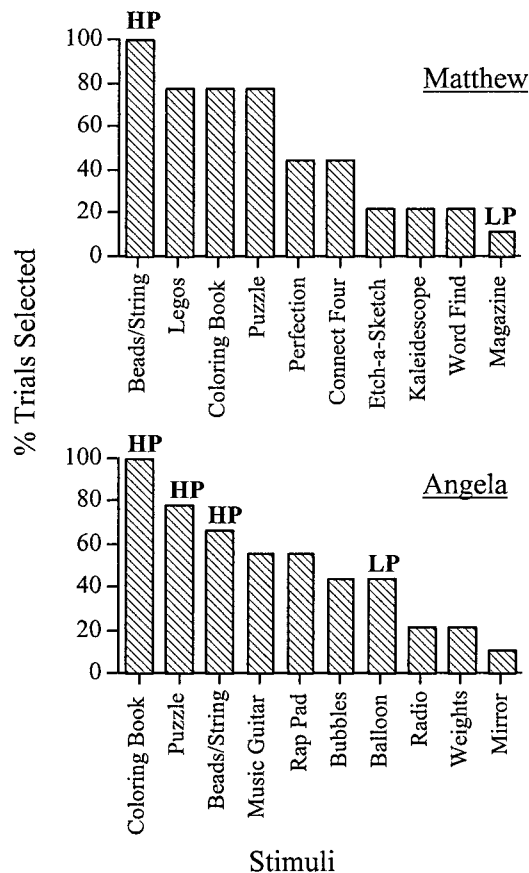

Figure 1.   Results of Matthew's and Angela's leisure-item preference assessment. Items designated HP and LP were used in Phase 2 (Study 1).

items, respectively, in Phase 2. Rather than selecting the most and least preferred items for Angela's Phase 2 analysis, we assessed competition between her most preferred item (coloring book and crayons, selected on 100% of trials) and an item for which preference was moderate (balloons, selected on 44% of trials). Angela also showed strong preference for the puzzle (selected on 78% of trials) and beads and string (selected on 67% of trials); both of these were also included as HP items in her Phase 3 analysis.

Phase 2: Brief NCR Evaluation

The effects of NCR were evaluated during 10-min sessions in a nonconcurrent multiple baseline design across participants. A reversal
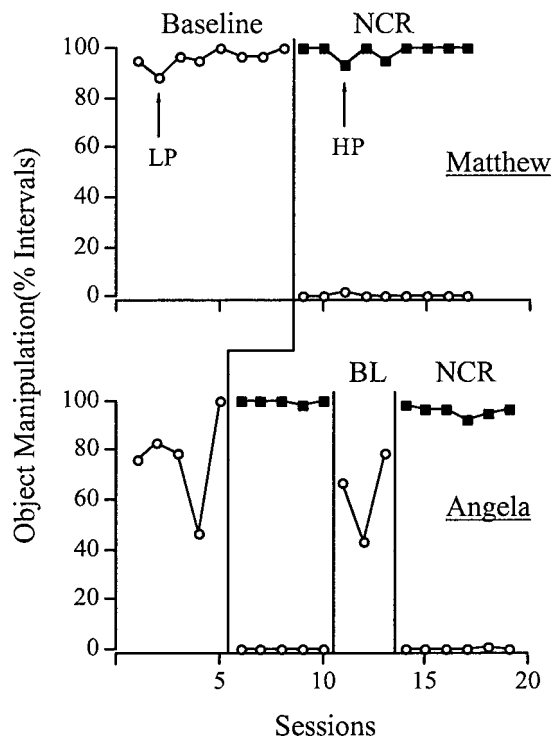
Figure 2. Percentage of intervals of object manipulation during Matthew's and Angela's 10-min baseline and NCR sessions of Phase 2 (Study 1).

design was also included in Angela's assessment. Two to four sessions were conducted per day, usually 5 days per week. At the beginning of each session, the therapist placed the items on the table in front of the participant but gave no further instructions and delivered no consequences for any of the participant's behavior. At the end of the session, the therapist informed the participant that the session was over and removed the items from the table. During baseline, only the LP item was available; during NCR, both the LP and the HP items were available.

Figure 2 shows the percentage of intervals of object manipulation for Matthew and Angela. When only the LP item was available, the participants manipulated it almost continuously (Matthew) or at high levels (Angela) throughout the baseline sessions. When both the LP and the HP items were available, both participants' manipulation of the LP item quickly ceased and was replaced by almost continuous manipulation of the HP item. These short-term effects, although not surprising, were a prerequisite for conducting the next phase of the study, which involved the evaluation of long-term NCR effects.

Phase 3: Extended NCR Evaluation

The effects of NCR were evaluated during continuous 120-min sessions using a reversal design (Angela only). One session was conducted daily. During the first condition (NCR constant), the participant had access to both the LP and HP items. This condition was identical to the NCR condition in Phase 2, except for the duration of sessions. During the second condition (NCR varied), the participant had access to the LP item and to three different HP items (selected from Phase 1). During this condition, all of the items were placed on a table in front of the participant, who was allowed to manipulate any of the items throughout the session.

Figure 3 shows the percentage of intervals of object manipulation during the 120-min sessions, which are partitioned into 20-min blocks to allow detection of within-session trends. When the LP and HP items were available (NCR constant), Matthew manipulated the HP item almost continuously and never manipulated the LP item; this pattern was observed across four 120-min sessions. Because he never manipulated the LP item during the 8 hr of observation, he was not exposed to the NCR-varied condition. Results obtained for Angela were much different. When the LP and HP items were available to Angela during the 120-min sessions, she initially showed strong preference for the HP item. However, toward the end of the NCR-constant sessions, her manipulation of the HP item decreased and her manipulation of the LP item increased. Her prefer-
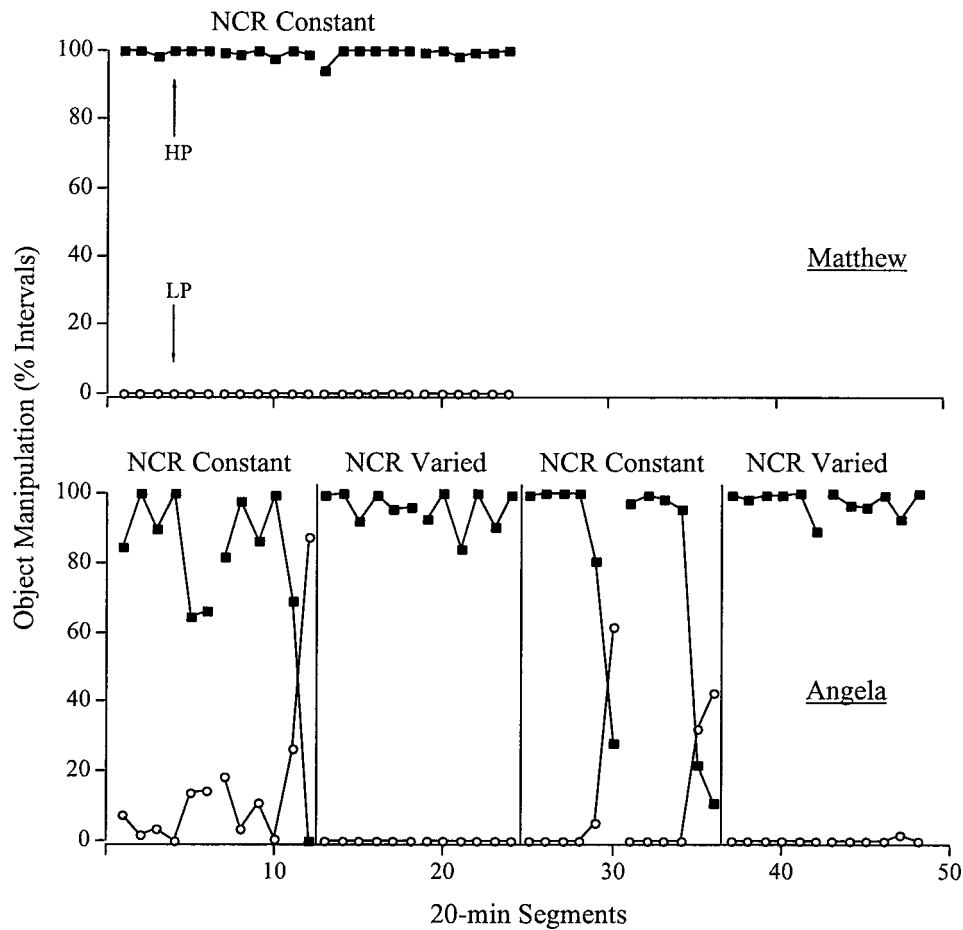
Figure 3. Percentage of intervals of object manipulation during Matthew's and Angela's 120-min NCR-constant and NCR-varied sessions of Phase 3 (Study 1). Data are presented in 20-min blocks.

ence actually switched at the end of the second NCR-constant session. When Angela was given access to three HP items (NCR varied), manipulation of these items remained high throughout the 120-min sessions, whereas manipulation of the LP item remained at or near zero. These results were replicated when the NCR-constant and the NCR-varied conditions were presented a second time.

DISCUSSION

Results of this study indicated that reinforcement obtained through manipulation of an HP item competed with that obtained through manipulation of an LP item when both were available during brief sessions. However, when HP and LP items were available over extended durations (120-min sessions), Angela showed apparent satiation to the HP item, as evidenced by decreased manipulation of the HP item and a subsequent increase in manipulation of the LP item. The effects of satiation appeared to be mitigated when Angela had access to varied HP items, because her contact with the HP items remained high during extended sessions, whereas contact with the LP item remained low.

These data suggest that when NCR consists of access to preferred leisure items and is used as treatment for problem behavior

maintained by automatic reinforcement, short-term positive results may not be predictive of those observed over extended periods of time. In cases in which the effects of NCR are not maintained for long periods, access to multiple HP items may represent one way to extend the usefulness of the intervention.

EXPERIMENT 2

Two distinct patterns of results were observed during the final phase of Experiment 1. Matthew's data suggested that noncontingent access to a highly preferred leisure item might represent an effective long-term treatment strategy for problem behavior maintained by automatic reinforcement. By contrast, Angela's data suggested that initial preference for reinforcement obtained from manipulating a highly preferred leisure item over that obtained from engaging in problem behavior may not be maintained due to satiation to the former item, leading to an eventual increase in problem behavior. The purpose of Experiment 2 was to determine if either of these two patterns would be observed when NCR was used to treat SIB maintained by automatic reinforcement. Specifically, we wanted to know if NCR would remain effective when used as an intervention during long (2-hr) sessions and when applied throughout the day. A secondary purpose was to determine if access to varied reinforcers (Egel, 1981) would ameliorate the effects of satiation if NCR lost its effects over time.

Experiment 2 was conducted in five phases. First, a functional analysis was conducted of 3 individuals' SIB to verify that it was not maintained by social reinforcement. Second, a preference assessment was conducted to identify leisure items that might compete with SIB when delivered noncontingently. Third, the effects of delivering the most highly preferred leisure item were assessed during brief NCR sessions. Fourth, the effects of NCR were assessed during extended sessions. Finally, NCR was conducted at 2 participants' homes over an extended amount of time, and observations were periodically conducted to assess the long-term effects of NCR under naturalistic conditions. As in Experiment 1, access to the specific leisure items used in this study was limited to experimental sessions, except as noted in Phase 5.

METHOD AND RESULTS

Participants and Setting

Three individuals who engaged in SIB participated. Julie was a 37-year-old woman who had been diagnosed with profound mental retardation and lived in a community-based group home and attended a sheltered workshop for persons with developmental disabilities. She was ambulatory, followed multiple-step directions, and used a few gestures to communicate. Her SIB consisted of hand mouthing. Laura was a 43-year-old woman who had been diagnosed with profound mental retardation and was nonambulatory. She did not reliably follow instructions or use any recognizable means of communication. Her SIB consisted of head hitting. Robert was a 30-year-old man who had been diagnosed with profound mental retardation; he had difficulty walking and spent most of his time in a wheelchair. He followed a few one-step directions and used gestures to communicate. His SIB consisted of forcefully rubbing his arms. Laura and Robert lived in a state residential facility for persons with developmental disabilities.

Julie's sessions during the first four phases were conducted at the sheltered workshop; Laura's sessions during the first four phases were conducted at a day program located on the grounds of the state residential facility. Observations for Julie and Laura during their fifth phase were conducted at their re-

spective homes, and all of Robert's sessions were conducted at his home.

Response Measurement and Reliability

The primary dependent variables were SIB and object manipulation. Julie's SIB was defined as insertion of her fingers past the plane of her lips or expulsion of saliva on her fingers. Laura's SIB was defined as forcefully striking her head with either hand. Robert's SIB was defined as forcefully rubbing one arm against the other in a sawing motion. Object manipulation was defined as physical contact with (i.e., holding or manipulating) a leisure item.

Data on Julie's and Robert's behavior were collected using paper and pencil on preprinted data sheets. Data on Laura's behavior were collected on a handheld computer. Data were summarized as either responses per minute (Laura's and Robert's SIB) or the percentage of 10-s intervals during which responding occurred (Julie's SIB and all participants' object manipulation).

Interobserver agreement was assessed by having a second observer independently collect data during 35.9%, 36.9%, and 25.5% of Julie's, Laura's, and Robert's sessions, respectively. Session time was divided into continuous 10-s intervals, and observers' records were compared on an interval-by-interval basis. Agreement for rate data was calculated by dividing the smaller number of responses by the larger number of responses in each interval, averaging these values across the session, and multiplying by 100%. Agreement for interval data was calculated by dividing the number of intervals containing agreements (on the occurrence or non-occurrence of behavior) by the total number of intervals and multiplying by 100%. Mean agreement scores were 97.4% (range, 90% to 100%), 95.2% (range, 75.7% to 100%), and 92.8% (range, 83.3% to 100%), respectively, for Julie's, Laura's, and Robert's SIB; and 99.1% (range, 93.1% to 100%),

91.7% (range, 47.4% to 100%), and 93.7% (range, 81.7% to 100%), respectively, for Julie's, Laura's, and Robert's object manipulation.

Phase 1: Functional Analysis

Participants were exposed to four assessment conditions (attention, demand, alone, and play) in a multielement functional analysis based on procedures described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994). Four to eight sessions were conducted daily, usually 5 days per week. During the attention condition, the participant had access to arbitrarily selected leisure materials, and the experimenter ignored the participant except to deliver attention (verbal expressions of concern) each time the participant engaged in SIB. This condition was a test for maintenance by positive reinforcement in the form of attention. During the demand condition, the experimenter initiated instructional trials at 30-s intervals using a series of graduated prompts (instruction, demonstration, and physical prompting). Praise was delivered following compliance, and the trial was terminated following SIB. This condition was a test for maintenance by negative reinforcement in the form of escape from demands. In the alone condition, the participant did not have access to leisure materials, and no social consequences were delivered following SIB. This condition was designed to determine whether SIB persisted in the absence of social consequences. During the play condition, the participant had access to leisure materials (as in the attention condition), and the experimenter delivered attention to the participant on an FT 30-s schedule. This condition was a control for the other test conditions.

Figure 4 shows the percentages of intervals of SIB exhibited by Julie and the rates (responses per minute) of SIB exhibited by Laura and Robert during their functional analyses. Julie engaged in very low levels of
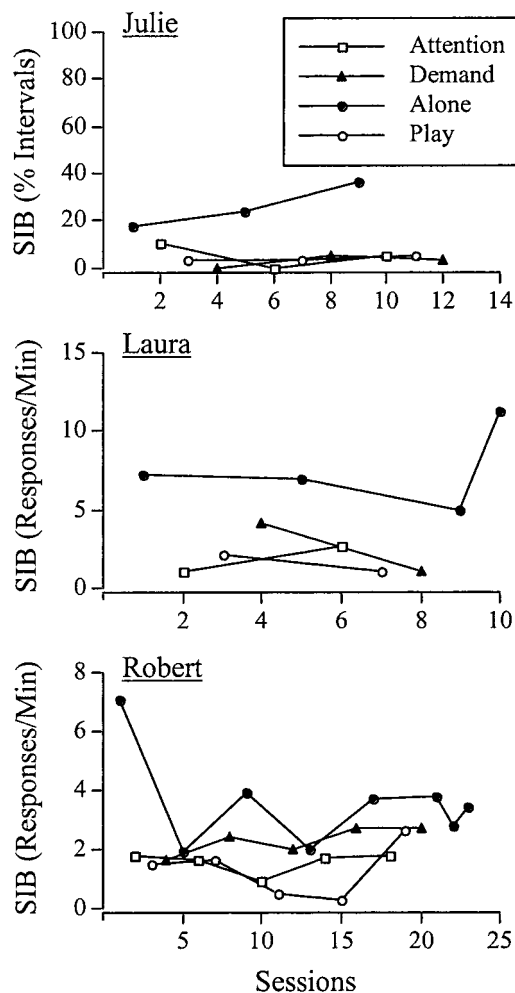
Figure 4. Levels of SIB exhibited by Julie, Laura, and Robert across functional analysis conditions (Phase 1, Study 2).

SIB during the attention, demand, and play conditions and moderate levels of SIB during the alone condition. Laura engaged in SIB in all conditions, but her highest rates of SIB occurred during the alone condition. Robert also engaged in SIB in all conditions, and his data contained overlapping points from several conditions. However, his highest rates of SIB occurred during the alone condition. Thus, results obtained for all 3 participants indicated that their SIB was not differentially sensitive to social reinforcement and that it occurred most often during the alone condition, suggesting that their SIB was maintained by automatic reinforcement.

Phase 2: Preference Assessment

The participants' preference for 10 leisure items was assessed using procedures similar to those described by DeLeon, Iwata, Conners, and Wallace (1999) to allow concurrent measurement of object manipulation and SIB. Prior to the assessment, the therapist familiarized the participant with each leisure item. At the beginning of each trial (4-min trials for Laura and Robert; 5-min trials for Julie), the therapist handed one item to the participant. The therapist did not interact with the participant during the trial except to retrieve a dropped item and to place it within a participant's reach, which rarely occurred. During the trial, an observer recorded duration of object manipulation (with a stopwatch) and SIB (as described previously). Each item was assessed on three different occasions in a randomized sequence, for a total of 12 min (Laura and Robert) or 15 min (Julie) per item.

Figure 5 shows results of the preference assessments. Each leisure item is represented by two data points. Data are sequenced in descending order from left to right based on duration of object manipulation. Results for all participants show an inverse relation between object manipulation and SIB, which was especially pronounced in Robert's data.

The item labeled C for each participant (beads and string for Julie, a ribbon for Laura, and a vibrating ball for Robert) was associated with the longest duration of object manipulation and the lowest level of SIB. This item was delivered during NCR-constant sessions in Phases 3 and 4 of the study. The items labeled V on Laura's and Robert's graphs were other leisure materials that also were associated with relatively longer durations of object manipulation and lower rates of SIB. These items were delivered during
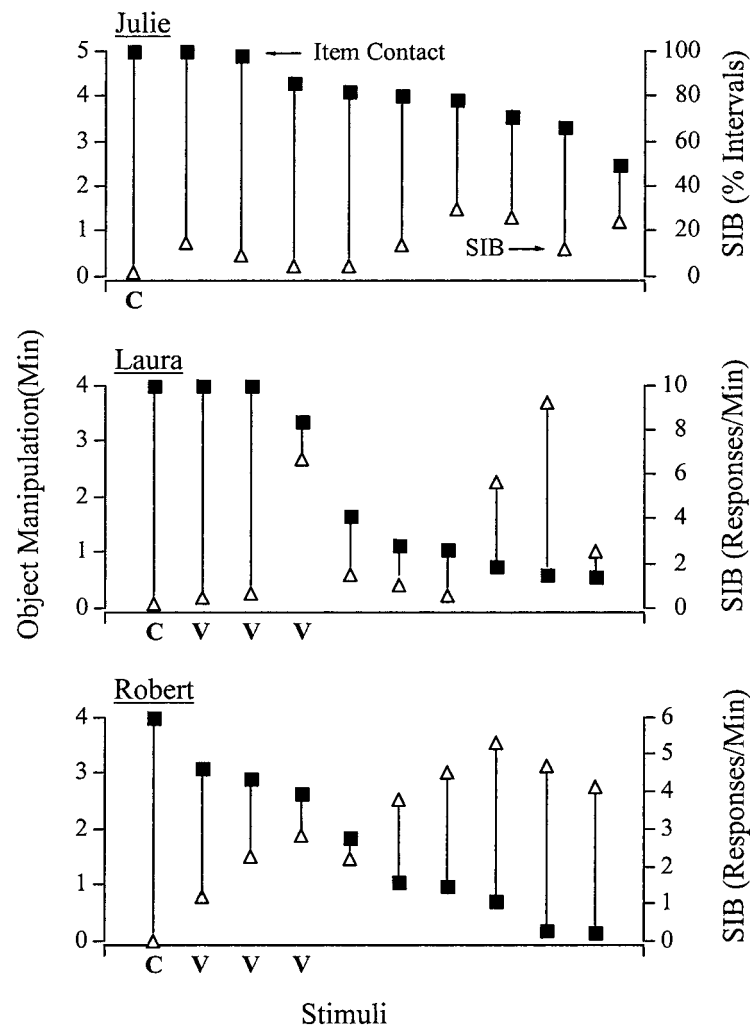
Figure 5. Duration of object manipulation and amount of SIB exhibited by Julie, Laura, and Robert during their preference assessments (Phase 2, Study 2). The squares show mean duration of object manipulation; the triangles show mean percentage of intervals or rate of SIB. Items designated C and V were used in subsequent phases during NCR-constant and NCR-varied conditions, respectively.

NCR-varied sessions in Phase 4. The items identified for Laura were a string of beads, a plastic ring with string, and a rubber worm. The items identified for Robert were a bumble ball, a handheld massager, and a radio.

Phase 3: Brief NCR Evaluation

The effects of NCR were evaluated during 10-min sessions using reversal designs. Two to four sessions were conducted daily, usually 5 days per week. The baseline condition was identical to the alone condition of the functional analysis; the participant did not have access to leisure items or to any social interaction. During NCR, the individual had free access to the leisure item associated with the longest duration of object manipulation and the lowest rate of SIB during the preference assessment (C in Figure 5). At the beginning of each session, the therapist placed the leisure item on a small table within the participant's reach (Julie and Robert) or on the participant's wheelchair tray (Lau-
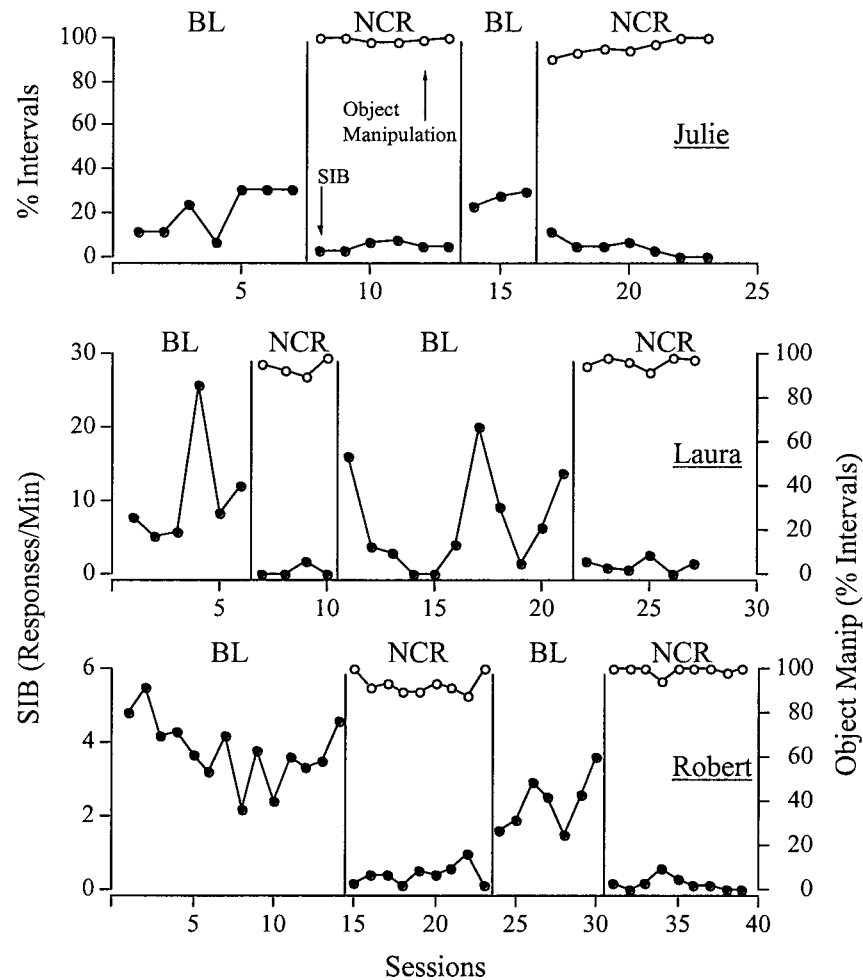
Figure 6. Levels of SIB exhibited by Julie, Laura, and Robert during 10-min baseline and NCR-constant sessions (Phase 3, Study 2). Julie's data are summarized as percentage of intervals of SIB; Laura's and Robert's data are summarized as responses per minute of SIB.

ra) but delivered no further instructions and did not interact with the participant except to retrieve a dropped item and replace it on the table or tray. At the end of the session, the therapist informed the participant that the session was over and removed the materials.

Figure 6 shows levels of SIB during the 10-min baseline and NCR sessions. Julie engaged in moderate levels of SIB during the baseline conditions. Her SIB decreased to low levels during NCR when she had access to the set of beads and string, and she manipulated the beads and string during a mean of 99.6% of the intervals. Laura engaged in variable but often high rates of SIB during both baseline conditions. Her rate of SIB immediately decreased when she was given access to the ribbon (she manipulated the ribbon during a mean of 94.7% of the intervals). Robert engaged in somewhat more stable and moderate rates of SIB during the baseline conditions. His rate of SIB quickly decreased when he had access to the bumble ball, which he manipulated during a mean of 96.2% of the intervals. Thus, data for all 3 participants showed that continuous access to their most preferred leisure item

produced immediate and substantial decreases in SIB and near-continuous engagement in the leisure activity.

Phase 4: Extended NCR Evaluation

The effects of NCR were evaluated during 120-min sessions using a reversal design (Laura only). One session was conducted per day. The NCR-constant condition was identical to the NCR condition in Phase 3 in which the participant had continuous access to the most preferred item throughout each session. During the NCR-varied condition, the participant had free access to several items associated with high levels of object manipulation and low levels of SIB during the leisure-item preference assessment (Phase 2, V in Figure 5). At the beginning of the NCR-varied sessions, all leisure items were placed on the participant's wheelchair tray (Laura) or on a nearby table (Robert).

Figure 7 shows levels of SIB across 120-min NCR-constant and NCR-varied sessions. Each data point represents a 20-min segment; each connected series of data points represents one 120-min session. Julie's SIB remained low across five NCR-constant sessions, during which she manipulated the beads and string in 100% of the intervals. Because the therapeutic effects of access to a single item were maintained across repeated 120-min sessions, the NCR-varied condition seemed unnecessary and was not implemented with Julie.

Laura's rate of SIB was low at the beginning of her first NCR-constant session but increased as the session continued; this pattern was observed in several other NCR-constant sessions. By contrast, her SIB remained low throughout the 120-min periods when she had access to varied leisure items. An inverse relation between Laura's SIB and object manipulation was observed during a number of NCR-constant sessions; that is, SIB increased as object manipulation decreased. By contrast, her object manipula-

tion remained high throughout the NCR-varied sessions. Thus, her mean level of object manipulation was lower during NCR-constant sessions (58.3%) than it was during NCR-varied sessions (95.2%). Anecdotal observations of Laura's behavior during NCR-varied sessions indicated that she often manipulated one of the leisure items (the string of beads) to the exclusion of the other items.

Robert's SIB during the NCR-constant condition also occurred at low rates at the beginning of sessions but increased as the sessions continued. However, when Robert was given access to multiple leisure items during the NCR-varied condition, he continued to engage in high rates of SIB throughout the 120-min sessions. Robert's level of object manipulation was high at the beginning of the NCR-constant sessions but quickly dropped off as the session progressed. This pattern was not observed during NCR-varied sessions; Robert engaged in moderate levels of object manipulation throughout the sessions.

Phase 5: Naturalistic NCR Evaluation

Because the therapeutic effects of NCR did not endure during Robert's 120-min sessions in Phase 4, only Julie and Laura participated in this final phase. NCR was evaluated in a nonconcurrent multiple baseline design across participants when intervention was implemented on a daily basis in the participants' homes. During baseline, Julie and Laura were observed at home during unstructured activity times. They typically did not have access to many leisure items during these periods. Therapists then instructed staff members in both participants' homes on the use of leisure materials evaluated in Phase 4, and the staff members selected various times each day to implement the NCR procedure. During NCR, Julie was given a set of beads and string during unstructured activity periods in the
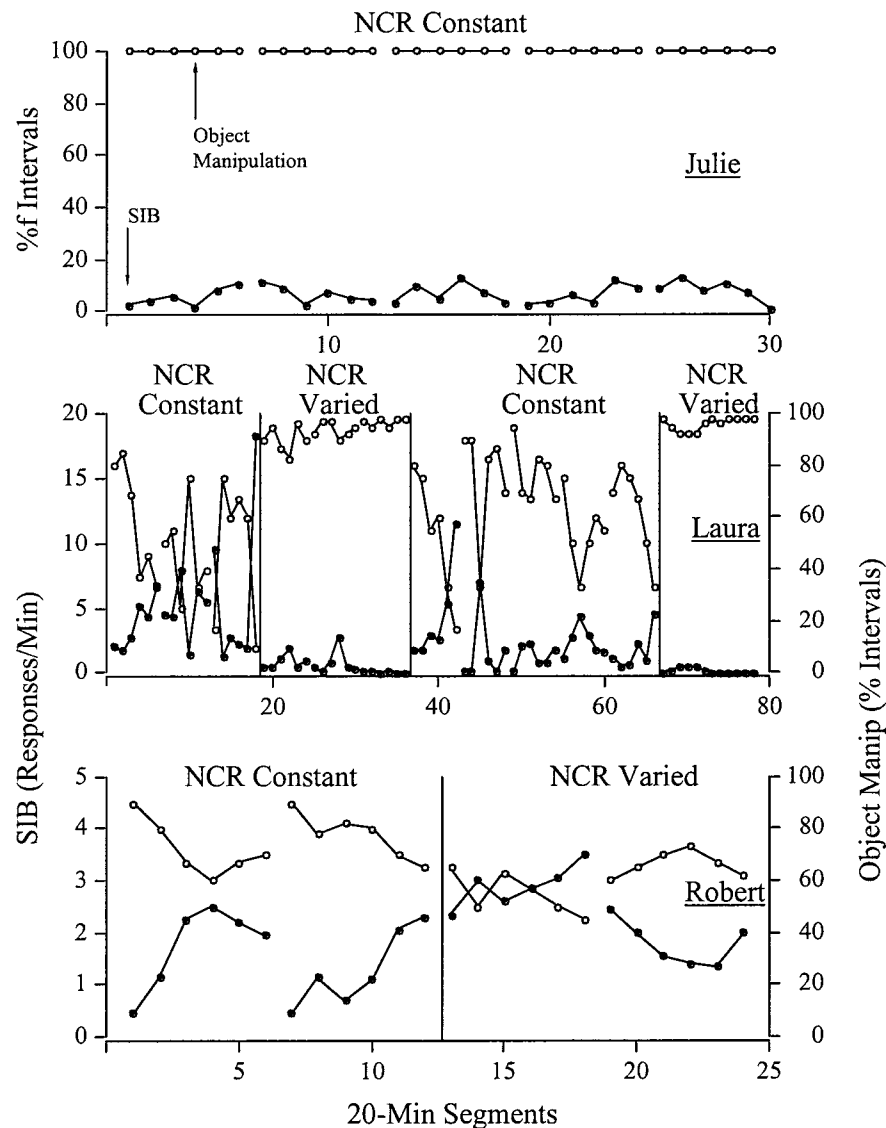
Figure 7. Levels of SIB exhibited by Julie, Laura, and Robert across 120-min NCR-constant and NCR-varied sessions (Phase 4, Study 2). Data are presented in 20-min blocks.

afternoon and evening each weekday and throughout the day on weekends; Laura was given access to varied leisure items throughout the day when formal training activities were not scheduled.

Data were collected during random and unannounced 10-min observation periods under baseline and NCR conditions. Julie's observations were conducted two to three times per week in the dining room of her

home during the afternoon or early evening over a 3-month period. Laura's observations were conducted three to five times per week at various times between 9:00 a.m. and 4:00 p.m. for 5 months, with two additional sessions scheduled 4 and 7 months later. Data were collected in several locations throughout Laura's home (both indoors and outdoors) during group leisure periods or while Laura was alone in her room, depending on
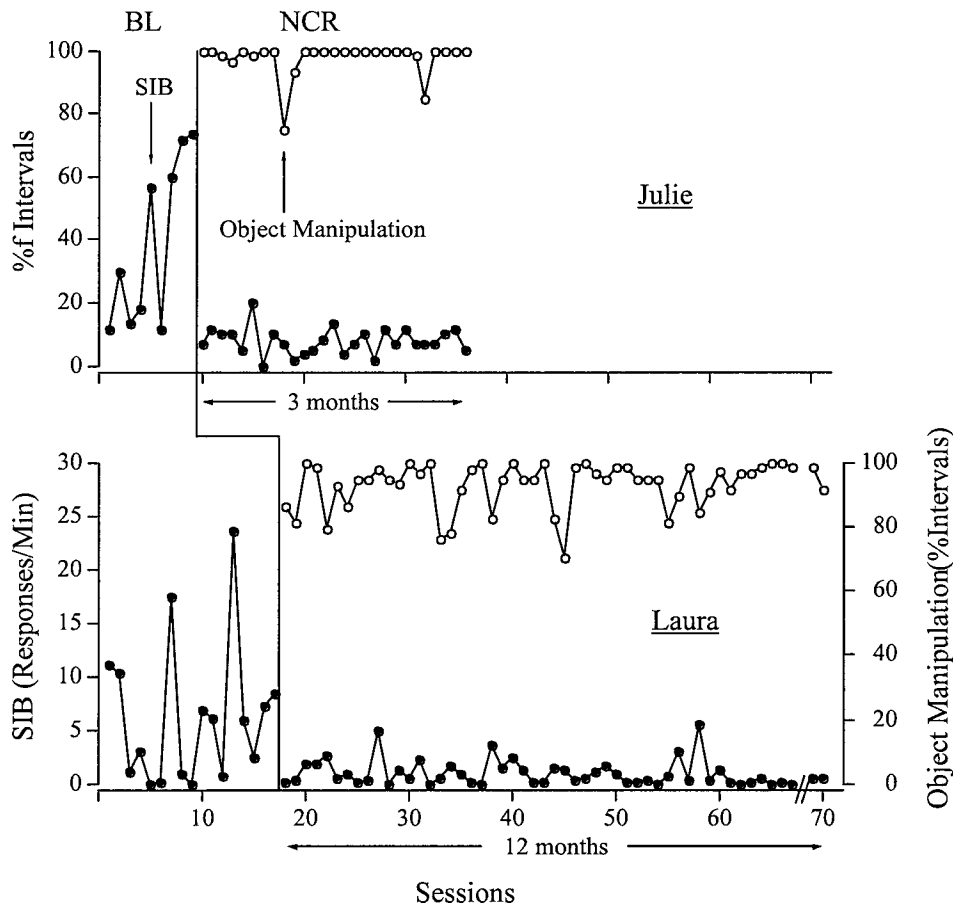
Figure 8.   Levels of SIB and object manipulation exhibited by Julie and Laura during observations at home while NCR was implemented daily (Phase 5, Study 2).

where she was when the observer visited her home.

Figure 8 shows data on Julie's and Laura's SIB and object manipulation during observation sessions conducted in their homes. Julie engaged in moderate to high levels of SIB during baseline. During NCR, when Julie had access to beads and string, her SIB decreased and remained low throughout the condition, whereas her object manipulation was maintained at high levels. Laura's rate of SIB was extremely variable during baseline. During NCR, when Laura had free access to varied leisure items, her SIB remained generally low, although periodic increases were observed during some sessions. Laura engaged in high levels of object manipulation

during the NCR condition. When additional observations were conducted 4 and 7 months later, Laura's rate of SIB was 0.5 per minute on both occasions, and her object manipulation averaged 95.1% of the intervals.

DISCUSSION

Results from Experiment 2 indicated that reinforcers obtained through leisure-item manipulation competed with those obtained automatically through SIB during brief (10-min) NCR sessions. These effects were maintained for 1 participant (Julie) during extended (120-min) NCR sessions. Julie's results followed the pattern of results obtained with Matthew in Experiment 1.

By contrast, the therapeutic effects of NCR observed during 10-min sessions were not maintained during Laura's and Robert's extended NCR evaluations; their SIB increased during 120-min sessions. It appeared that both participants became satiated to the reinforcers obtained through object manipulation during the extended sessions, as reflected by decreased levels of object manipulation within the sessions.

Data from Laura's 120-min NCR-varied sessions suggested that access to multiple reinforcers might mitigate the effects of satiation during long NCR sessions. When she had access to several highly preferred leisure items, object manipulation remained high and SIB remained low throughout the 120-min sessions. Laura's data were similar to the pattern of results obtained with Angela in Experiment 1. It is interesting to note that Laura often manipulated the beads almost exclusively during her NCR-varied sessions. Thus, had beads been available during the NCR-constant sessions, it is possible that object manipulation may have remained high and SIB remained low throughout the sessions, as was observed during the NCR-varied sessions. Those results would have been similar to the pattern of results obtained with Matthew in Experiment 1. The beads were not available during the NCR-constant sessions because results of Laura's preference assessment suggested that the ribbon was equally preferred and was associated with lower levels of SIB. Nonetheless, the current results and the anecdotal reports from Laura's NCR evaluations suggest that providing multiple items may increase the chances that at least one of the items will effectively compete with the target behavior, even if reinforcer variation per se was not the key to extending the long-term therapeutic effects of NCR.

Data from Julie's and Laura's naturalistic NCR evaluations demonstrated that the intervention remained effective when implemented daily over long periods of time (3 months for Julie; 12 months for Laura). These results are promising because Julie's and Laura's treatment gains were maintained with very little effort on the part of caregivers.

Finally, the results from Robert's evaluation indicated that, although NCR was effective during 10-min sessions, the effects were not maintained during 120-min sessions, and that access to varied leisure items seemed to produce little or no benefit. Thus, additional interventions would be necessary to achieve long-term reductions in Robert's SIB.

GENERAL DISCUSSION

The current experiments provide comparative data on the short- and long-term effects of NCR. In Experiment 1, NCR effects were examined with 2 participants' arbitrary responses; in Experiment 2, NCR was used as treatment with 3 participants whose SIB was maintained by automatic reinforcement. Results showed that reinforcers obtained through manipulation of highly preferred leisure items readily competed with those obtained from less preferred items (Experiment 1) or from SIB (Experiment 2) during brief (10-min) sessions. However, data from 120-min NCR sessions indicated that satiation to a specific leisure item might occur over periods of time more typical of those during which treatment would be implemented. Varied reinforcers (leisure items) were subsequently introduced during 120-min sessions and were found to extend the effectiveness of NCR for some individuals. Finally (Experiment 2 only), NCR was implemented throughout the day in participants' homes, and therapeutic effects were shown to be maintained for up to 1 year.

The analogue nature of Experiment 1 raises questions about its relevance to the study or treatment of behavior in applied

settings. Although the dependent variables consisted of arbitrary responses and the independent variable differed from the manner in which NCR is typically implemented, the methodology used in Experiment 1 closely approximated conditions under which NCR might be used as treatment for problem behavior maintained by automatic reinforcement. As such, Experiment 1 permitted an examination of NCR-like effects under brief and extended application, as well as the evaluation of an intervention that might prevent satiation due to repeated exposure to reinforcers. Although these objectives could have been achieved entirely in a clinical context, as they were in Experiment 2, the analogue arrangement illustrated in Experiment 1 may serve two useful functions. First, by providing a bridge between basic and applied research, it serves as a basis for conducting subsequent clinical studies. In the present case, conditions permitted us to conduct both the bridge study and its clinical extension, and we reported them together to emphasize their methodological similarities. Second, under other circumstances, as in the case of extremely high-risk behavior, analogue studies may represent the only means for conducting parametric, component, or comparative analyses of intervention effects prior to treatment implementation.

Results obtained during the short-term implementation of NCR were extremely consistent across the 5 participants (Experiments 1 and 2) and replicated findings from a number of studies showing that access to highly preferred leisure items produces decreases in problem behavior maintained by automatic reinforcement. By contrast, when NCR was implemented during the 120-min sessions, different results were obtained across participants. The basis for these differences is not entirely clear; however, close examination of data from the preference assessments yields some interesting relations. More specifically, these data seemed some-

what predictive of participants' performance during the 120-min NCR sessions.

Matthew's HP and LP items were those chosen most frequently and least frequently, respectively, during his preference assessment (Figure 1). Similarly, every leisure item included in Julie's preference assessment successfully competed with her SIB; that is, object manipulation was higher than SIB for every item assessed (Figure 5). Thus, both participants' assessment data suggested a pronounced lack of preference for the target behavior in that manipulation of the LP item (Matthew) and SIB (Julie) were displaced by all other leisure items. Perhaps these results accounted for the fact that both participants showed no satiation to reinforcement associated with the single HP item during 120-min NCR sessions (Matthew, Figure 3; Julie, Figure 7).

Data from Angela's, Laura's, and Robert's preference assessments showed a different pattern. Angela's LP item (unlike Matthew's) was more preferred than several other leisure items; it was chosen on about half of the trials (Figure 1). Laura and Robert also showed preference for SIB over several leisure items (Figure 5). Thus, it might be expected that access to a single HP item would not compete with these participants' target behaviors during 120-min NCR sessions.

Finally, access to varied HP items competed with Laura's SIB but not with Robert's SIB during 120-min sessions. Data from their preference assessments revealed that three of Laura's four leisure items but only one of Robert's three items were associated with long durations of object manipulation and low levels of SIB. Thus, Robert's NCR-varied condition was comprised of leisure items that, as a group, did not compete as favorably with SIB.

This account is somewhat speculative in the absence of additional parametric manipulations. Nevertheless, the correspondence between results of participants' preference as-

sessments and their long-term NCR evaluations suggests that strong preference for multiple leisure items may be an indicator of whether NCR effects are likely to be maintained over long periods of time. When such preference is not observed or when mere access to leisure items does not compete with problem behavior, supplemental interventions such as response blocking, prompting, and shaping may be necessary (e.g., Hanley, Iwata, Thompson, & Lindberg, 2000; Lindberg, Iwata, & Kahng, 1999; Ringdahl, Vollmer, Marcus, & Roane, 1997).

The present study contained limitations that should be noted. First, data were not collected on which leisure items were manipulated during the NCR-varied sessions. According to anecdotal reports, Laura often manipulated the beads to the exclusion of other leisure items during this condition; thus, more fine-grained data would have been informative. Stimulus variation may have decreased the likelihood that Laura would become satiated to any one reinforcer; alternatively, access to varied stimuli may have enabled her to select the one item that she would not quickly tire of. In either case, stimulus variation effectively extended the effects of NCR during 120-min sessions and when implemented under naturalistic conditions over several months.

Second, although data from the final phase of Experiment 2 documented the efficacy of NCR over a long period of time, our sampling procedure (data collected several times per week during brief sessions) did not allow a determination of the consistency with which NCR was implemented. Because staff members were unaware of the observation schedule, it is likely that NCR sessions generally were conducted as prescribed. It is possible, however, that sessions were conducted sporadically following an observation because only one sample was taken on any given day.

Despite these limitations, the study's main findings were clear in showing that interventions that essentially eliminated target behaviors during brief sessions had diminishing effects when applied over longer periods of time in three of the five cases. These results highlight the importance of evaluating the therapeutic effects of intervention under naturalistic conditions. Initial treatment development, as well as complex analyses needed for refinement, are best accomplished under well-controlled conditions. In clinical practice, however, treatment is usually applied under less favorable circumstances. Therefore, treatment procedures first developed under laboratory conditions should eventually be tested under conditions similar to those in which the treatment will be used. Failures during such implementation should be expected and will lead to the discovery of supplemental or alternative techniques through additional well-controlled research.

REFERENCES

Carr, J. E., Coriaty, S., Wilder, D. A., Gaunt, B. T., Dozier, C. L., Britton, L. N., et al. (2000). A review of "noncontingent" reinforcement as treatment for the aberrant behavior of individuals with developmental disabilities. *Research in Developmental Disabilities, 21,* 377–391.

DeLeon, I. G., Anders, B. M., Rodriguez-Catter, V., & Neidert, P. L. (2000). The effects of noncontingent access to single- versus multiple-stimulus sets on self-injurious behavior. *Journal of Applied Behavior Analysis, 33,* 623–626.

DeLeon, I. G., Iwata, B. A., Conners, J., & Wallace, M. D. (1999). Examination of ambiguous stimulus preferences with duration-based measures. *Journal of Applied Behavior Analysis, 32,* 111–114.

Egel, A. L. (1981). Reinforcer variation: Implications for motivating developmentally disabled children. *Journal of Applied Behavior Analysis, 14,* 345–350.

Fisher, W. W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25,* 491–498.

Goh, H., Iwata, B. A., Shore, B. A., DeLeon, I. G., Lerman, D. C., Ulrich, S. M., et al. (1995). An analysis of the reinforcing properties of hand

mouthing. *Journal of Applied Behavior Analysis, 28,* 269–283.

Hagopian, L. P., LeBlanc, L. A., & Maglieri, K. A. (2000). Noncontingent attention for the treatment of excessive medical complaints in a medically fragile man with mental retardation. *Research in Developmental Disabilities, 21,* 215–221.

Hanley, G. P., Iwata, B. A., Thompson, R. H., & Lindberg, J. S. (2000). A component analysis of "stereotypy as reinforcement" for alternative behavior. *Journal of Applied Behavior Analysis, 33,* 285–297.

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27,* 197–209. (Reprinted from *Analysis and Intervention in Developmental Disabilities, 2,* 3–20, 1982)

Lindberg, J. S., Iwata, B. A., & Kahng, S. K. (1999). On the relation between object manipulation and stereotypic self-injurious behavior. *Journal of Applied Behavior Analysis, 32,* 51–62.

Mace, F. C., & Lalli, J. S. (1991). Linking descriptive and experimental analyses in the treatment of bizarre speech. *Journal of Applied Behavior Analysis, 24,* 553–562.

Michael, J. (1982). Distinguishing between discriminative and motivational functions of stimuli. *Journal of the Experimental Analysis of Behavior, 37,* 149–155.

Michael, J. (1993). Establishing operations. *The Behavior Analyst, 16,* 191–206.

Ringdahl, J. E., Vollmer, T. R., Marcus, B. A., & Roane, H. S. (1997). An analogue evaluation of environmental enrichment: The role of stimulus preference. *Journal of Applied Behavior Analysis, 30,* 203–216.

Roscoe, E. M., Iwata, B. A., & Goh, H. (1998). A comparison of noncontingent reinforcement and sensory extinction as treatments for self-injurious behavior. *Journal of Applied Behavior Analysis, 31,* 635–646.

Shore, B. A., & Iwata, B. A. (1999). Assessment and treatment of behavior disorders maintained by nonsocial (automatic) reinforcement. In A. C. Repp & R. H. Horner (Eds.), *Functional analysis of problem behavior: From effective assessment to effective support* (pp. 117–146). Belmont, CA: Wadsworth.

Vollmer, T. R., Marcus, B. A., & LeBlanc, L. (1994). Treatment of self-injury and hand mouthing following inconclusive functional analyses. *Journal of Applied Behavior Analysis, 27,* 331–344.

Vollmer, T. R., Marcus, B. A., & Ringdahl, J. E. (1995). Noncontingent escape as treatment for self-injurious behavior maintained by negative reinforcement. *Journal of Applied Behavior Analysis, 28,* 15–26.

STUDY QUESTIONS

1. Why might problem behavior maintained by automatic reinforcement be more likely to reemerge than problem behavior maintained by social reinforcement when NCR is used as treatment over long periods of time?

2. What rationale did the authors give for their selection of target responses in Experiment 1?

3. To what did the authors attribute increases in Angela's manipulation of the LP item during the NCR-constant condition in Experiment 1, and how did they attempt to mitigate that trend?

4. Summarize the results of the functional analyses and discuss how they were a precondition to conducting Experiment 2.

5. On what basis were leisure items selected during Experiment 2?

6. Summarize the patterns of responding observed for each participant during the brief and extended NCR evaluations in Experiment 2.

7. What are the benefits of conducting analogue studies such as those illustrated in Experiment 1?

8. How were results of the preference assessments somewhat predictive of those obtained during the NCR-extended condition?

Questions prepared by David Wilson and Carrie Dempsey, The University of Florida